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and there are here depicted the early periods of forest destruction, the fluctuations in forest area associated with peace and war, and the growth of the ideas of conservation and afforestation. The closing chapters consider changes in the composition of forests and the problems of heaths and moors, which are discussed from the viewpoint of origin, of destiny if left to themselves, and of utilization by man. The great merit of this volume lies in its strongly dynamic attitude, an attitude that cannot be too highly commended in all phytogeographic work.—H. C. COWLES.

### The trees of Belgium

MASSART<sup>4</sup> has issued a profusely illustrated little book on the trees of Belgium, his object being to present the subject so as to interest intelligent lovers of the woods, rather than to make a manual for botanists or foresters. The book is in no sense designed as a manual of identification, but rather it presents the interesting problems about which the nature-lover is likely to inquire. In the first portion of the book MASSART considers wood structure and tree architecture. Then follows a section on the relation between trees and soil, and a similar section on the relation between trees and the atmosphere. The final section presents the life-history of trees, dealing with birth, competition, decrepitude, and death. In the chapter on tree architecture, the author discusses deliquescent and excurrent trees, regeneration of injured terminal and lateral branches, the influence of isolation on the shape of the crown, and enlarged trunk bases. The section on soil relations considers the distribution of trees (an excellent detailed map of the Belgian woodlands accompanies this), the influence of the soil on trees, and the influence of trees on the soil; among the topics treated under the latter heading are rock disintegration, fixation of dune sand, and chemical changes in the soil. In the final section much attention is paid to tree diseases and insect pests. It is a pity that we do not have many similar books to accommodate the rapidly increasing army of nature-lovers.—H. C. COWLES.

### NOTES FOR STUDENTS

**The vegetation of the Nebraska sandhills.**—The average traveler regards the prairies and plains as regions of extreme monotony; particularly is this true if his way takes him through a region of sandhills. The total incorrectness of this view is admirably illustrated by the publication of POOL's researches in the Nebraska sandhills.<sup>5</sup> From an earlier and semipopular presentation

<sup>4</sup> MASSART, J., *Nos arbres*. pp. viii+214. *figs.* 238. *map* 1. Brussels: Henri Lamertin. 1911.

<sup>5</sup> POOL, RAYMOND J., *A study of the vegetation of the sandhills of Nebraska*. Minn. Bot. Studies, III. 4:189-312. *pls.* 15. *figs.* 16. *map* 1. 1914.

by the same author<sup>6</sup> we had learned to know something of the fascination and scientific interest of these dynamic landscapes, and now we have his detailed results.

The Nebraska sandhill country covers an area of about 18,000 square miles, that is, nearly one-fourth of the area of the state. There are similar but smaller areas of sandhills in Kansas, Colorado, and the Dakotas. The soil is composed of dune sand, probably derived from the Loup Fork (Tertiary) beds. These hills seem to have been formed largely at some previous epoch and to have become stabilized and occupied by vegetation. Through the influence of man, mostly on account of prairie fires and overgrazing, many of these ancient dunes have become rejuvenated to the detriment of those responsible for it.

After giving the results of his careful measurements of wind, rainfall, evaporation, temperature, and other ecological factors, POOL takes up in detail the vegetation of the region. It is a pleasure to note the author's caution in using the word "formation." He rightly believes in using this term only for large units, referring the "formations" of many authors to associations. The characteristic upland formation is the prairie-grass formation, which is contrasted sharply with the short-grass formation of the plains, the two embracing most of the great climatic grasslands between our eastern forests and the mountains. These two great formations have similar physiognomy but different component species; the limiting factors are the available water and competition, and not temperature, as supposed by MERRIAM. The chief association is the bunch-grass association, dominated especially by *Andropogon scoparius*; this is the vegetation that prevailed generally before the advent of the white man, and is regarded as the temporary climax of the region. The vegetation of this association is open, the grasses occurring in tufts or bunches, but it is supposed that ultimately some closed prairie-grass association will prevail. There is evidence of this in the spear-grass association (dominated by *Stipa comata* and *Koeleria cristata*), and farther west in the grama buffalo-grass association (dominated by *Bouteloua* and *Bulbilis*).

Doubtless the most interesting features of the sandhills are the blow-outs. These are retrogressive features and are due, as noted above, especially to prairie fires and overgrazing. At first, through the death of the plants there are small patches of bare sand. Later the sand is scooped out by the wind, forming conical or crateriform depressions, known as blow-outs. As the sand is scooped out, more sand falls in from the sides, so that the blow-out is increased in circumference, as well as in depth. Extreme cases are recorded where the depth may be as much as 100 feet and the circumference 600 feet. When wind erosion becomes checked, vegetation again gets a foothold, the chief

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<sup>6</sup> POOL, RAYMOND, J., Glimpses of the Great American Desert. Pop. Sci. Monthly 80:209-235. figs. 17. 1912.

pioneers being *Calamovilfa longifolia*, *Psoralea lanceolata*, and *Redfieldia flexuosa*. After a time these pioneers are followed by the bunch-brass association; after this vegetational changes are much less rapid. One of the chief features of interest in the woodland formations along the streams is the overlap of the deciduous eastern forest and the yellow pine (*Pinus ponderosa scopulorum*) forest of the west. The lowland formations are much like those elsewhere both as to content and succession, except that a meadow type represents the temporary climax; probably one of the more eastern of the prairie-grass associations represents a more ultimate condition.—H. C. COWLES.

**The water-balance of desert succulents.**—The Sonoran desert is very rich in succulents which carry a large water-balance. Some of the most striking of these have been studied in detail for some years at the Desert Laboratory.<sup>7</sup> Mrs. SPALDING had previously shown that the stems of *Cereus giganteus* expand and contract in a most remarkable manner, as water is accumulated or lost.<sup>8</sup> These movements are readily measured by noting the variations in distance between the ridges from time to time. Mrs. SPALDING, as her part of the contribution, reports greatly extended experiments along this line on the same and on additional species. The earlier work has been confirmed in practically all respects. In addition to the influence of soil water in changing the plant form, insolation is found to be an important secondary factor; for example, the furrows on the south sides of stems are narrower than those on the north sides. The behavior of *Echinocactus Wislizeni* is much like that of *Cereus giganteus*, but in *Opuntia* the behavior is simpler, consisting merely of the swelling and shrinking of the stem segments.

MACDOUGAL's part of the work consisted of a study of variations in the water-balance, due to seasonal moisture fluctuations and other causes. The remarkable ability of these desert succulents to tide over long periods of drought is brought out in striking fashion in the case of plants of *Cereus giganteus*, in which branches have remained alive and even have bloomed a year after the main trunk bearing them has died. More efficient even than the cacti is *Ibervillea sonorae*, a plant whose stem base is tuberized. For ten years tubers of this species have remained alive, without a renewal of water supply, sending up short green stems each summer; during this time but half of the original weight had been lost. In the general conclusions attention is called to great differences in individual behavior under similar experimental conditions. The

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<sup>7</sup> MACDOUGAL, D. T., and SPALDING, E. S., The water-balance of succulent plants. Carnegie Institution of Washington, Publication 141. pp. 77. pls. 8. 1910. See also MACDOUGAL, D. T., The water-balance of desert plants. Ann. Botany 26:71-93. pls. 5. 1912.

<sup>8</sup> SPALDING, E. S., Mechanical adjustment of the Sahuaro (*Cereus giganteus*) to varying amounts of stored water. Bull. Torr. Bot. Club 32:57-68. 1905; see Bot. Gaz. 40:396. 1905.